technical note

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Instrument Landing System Mathematical Modeling Study for Orlando International Airport Runway 17R Localizer, Orlando, Florida, Revised Airside Docking Plan (Scheme IIIA)

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16. Abstract

This Technical Note describes the instrument landing system (ILS) math modeling performed by the Federal Aviation Administration (FAA) Technical Center at the request of the Southern Region. Upon the completion of a preliminary modeling effort described in Technical Note DOT/FAA/CT-TN88/35 "ILS Mathematical Modeling Study for Orlando International Airport Runway 17R," ASO-430 provided a final version of an airside ramp utilization plan (Scheme IIIA) for the Orlando Airport. This necessitated an additional modeling effort due to changes in aircraft docking arrangements, the addition of taxiing aircraft, and a Delta ramp operations control tower. Computed data are presented showing the effects of airside terminals with simulated docked and taxiing aircraft on the performance of an ILS localizer proposed for runway 17R at the Orlando International Airport. The Southern Region is concerned that reflections from two proposed airside terminals with docked and taxiing aircraft may degrade the localizer course beyond category II/III tolerances. Modeled course structure results indicate that marginal category II/III localizer performance should be obtained with the Wilcox Mark II, 14-element, dual-frequency log periodic antenna and both airside terminals with docked and taxiing aircraft at the currently proposed locations, excluding aircraft taxiing parallel to the runway. Category II/III course structure results are not obtained when the parallel taxiing aircraft are included in the reflecting source configuration. Computed clearance orbit results indicate satisfactory linearity, course crossover, and signal clearance levels.

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EXECUTIVE SUMMARY

This instrument landing system (ILS) math modeling study was performed at the request of the Southern Region to compute the effects of proposed airside terminals with docked aircraft on the performance of an ILS localizer proposed for runway 17R, which is under construction at the Orlando International Airport. Upon the completion of a preliminary modeling effort described in Technical Note DOT/FAA/CT-TN88/35 "ILS Mathematical Modeling Study for Orlando International Airport Runway 17R," ASO-430 provided a final version of an airside ramp utilization plan (Scheme IIIA) for the Orlando Airport. This necessitated an additional modeling effort due to changes in aircraft docking arrangements and the addition of taxiing aircraft and a Delta ramp operations control tower. Reflections from other structures on the airport are not considered in this modeling study. The localizer was modeled using a physical optics mathematical model developed by the Transportation Systems Center. As requested by ASO-433, a Wilcox Mark II, 14-element, dual frequency log periodic antenna array was modeled. Derogative effects from two airside terminals and simulated docked and taxiing aircraft in several reflecting source configurations were considered.

Modeled course structure results indicate that marginal category II/III localizer performance should be obtained for runway 17R with both airside terminals and docked and taxiing aircraft at the currently proposed locations, excluding aircraft taxiing parallel to the runway. Category II/III course results are not obtained when the parallel taxiing aircraft are included in the reflecting source configuration. Computed clearance orbit results indicate satisfactory linearity, course crossover, and signal clearance levels.

INTRODUCTION

PURPOSE.

The purpose of this math modeling study was to provide computer modeled performance data for an instrument landing system (ILS) localizer proposed for runway 17R at the Orlando International Airport.

BACKGROUND.

The Southern Region will be installing an ILS localizer to serve runway 17R, which is under construction at the Orlando International Airport. In support of this project, ASO-433 has requested a math modeling study through the Navigation and Landing Division, APS-400, which, in turn, was forwarded to the Federal Aviation Administration (FAA) Technical Center for accomplishment. Upon the completion of a preliminary modeling effort, described in Technical Note DOT/FAA/CT-TN88/35 "ILS Mathematical Modeling Study for Orlando International Airport Runway 17R Orlando, Florida, Preliminary Airside Docking Plan," ASO-430 provided a final version of an airside ramp utilization plan (Scheme IIIA) for the Orlando Airport. This necessitated an additional modeling effort due to changes in aircraft docking arrangements, the addition of taxiing aircraft, and a Delta ramp operations control tower. Localizer math modeling was requested for a Wilcox Mark II, 14-element, dual frequency log periodic dipole (LPD) antenna array to provide category II/III performance. ASO-433 requested modeling of several terminal airside configurations: airside terminal 4 only, with and without docked and taxiing aircraft; and airside terminals 4 and 2, with and without docked and taxiing aircraft. This modeling effort was performed under project T0605A. The Program Manager is Mr. Edmund A. Zyzys. Additional information regarding this study may be obtained by contacting Messrs. James D. Rambone or John E. Walls at FTS 482-4572 or (609) 484-4572.

DISCUSSION

ILS MATH MODELS.

The FAA Technical Center conducts ILS mathematical computer model studies through application of physical optics or geometric theory of diffraction techniques to compute anticipated ILS performance. The modeling for runway 17R localizer was performed using the physical optics localizer model developed by the Transportation Systems Center (TSC) and converted to the Technical Center's mainframe computer. References 1 through 3 describe the modeling technique and implementation. Reference 4 provides validation data for the localizer model.

The coordinate system used in this computer model is a right-handed system with the origin located at the threshold of the runway. The positive x-axis is directed out from the threshold along runway centerline extended, the positive y-axis is directed to the left, the positive z-axis is directed up. Alpha, the angle between the base of a reflector and the x-axis, is measured in the counterclockwise direction. A reflector facing in the negative y-direction has an alpha of 0°. Delta is the angle between the surface of the reflector and the vertical direction. A reflector with a delta of 0° is perpendicular to the ground. Delta is equal to -90° for a horizontal reflector facing down. A

surface illuminated by radio frequency (RF) energy from the antenna is modeled by a rectangular flat or cylindrical surface. The surface is considered to be of infinite conductivity over the total surface and to have zero thickness. This assumption will result in a worst-case performance prediction. The model does not compute multiple reflections or diffractions. Course deviation indicator (CDI) deflections are computed as follows. First, the magnitude and phase of the RF signals arriving at the aircraft location are determined for each surface independently. Next, a resultant RF signal is computed by vectorially combining the independent signals. CDI deflection is then computed from the resultant RF signal.

ILS MODELING PERFORMED.

Figure 1 shows the general orientation of the runway. The TSC localizer model was used to model the effects of the airside terminals and simulated docked and taxiing aircraft. As requested, the Wilcox Mark II, 14-element, dual frequency LPD antenna was modeled at the proposed ILS localizer site. Localizer course structure and clearance orbit computer runs were made for each of the reflective source configurations. Table 1 summarizes the localizer model input data. Antenna currents and phases used for the antenna array are also given in table 1.

The following criteria was used in selecting the surfaces for input to the model: (1) use all surfaces potentially illuminated by direct RF energy from the localizer antenna; (2) the airside terminals can shadow aircraft and each other; (3) aircraft cannot shadow terminals or other aircraft; (4) reflected RF energy is not shadowed; and (5) the effects from other structures on the airport are not considered.

The reflecting surfaces modeled are identified in figure 2. The aircraft (Boeing-747's, Boeing-757's, and Lockheed-1011's) were simulated at specific locations on the airport ramp areas, as given on an airside terminal layout chart, Scheme IIIA, provided by ASO-433. The simulated B-747 aircraft are numbered 17, 18, 19, 25, 26, 27, 28, and 29. The aircraft numbered 10, 11, 12, 13, 14, 20, and 21 are simulated L-1011's. The remaining aircraft were simulated as B-757's. Rectangular plates were used to simulate the aircraft fuselage and tail (figure 3). The location and dimensions of all reflecting surfaces are detailed in table 2. Cylinders were used to simulate the corners of the airsides (A and G in figure 2). A cylinder was also used to simulate the Delta ramp operations control tower (surface F in figure 2). Rectangular plates were used to simulate the other reflecting surfaces.

The reflecting source configurations modeled, per ASO-433 request, are as follows: (1) airside 4 only (surfaces A through F); (2) airside 4 with simulated docked and taxiing aircraft (airside 4 plus adjacent docked aircraft 7 through 24 and taxiing aircraft 25 through 33); (3) airside 4 and 2 without docked and taxiing aircraft (surfaces A through J); (4) airside 4 plus airside 2 with simulated docked and taxiing aircraft (airside 4 plus aircraft 7 through 33, and airside 2 with adjacent docked aircraft 1, 2, 3, and 16 through 24 and taxiing aircraft 28 through 33). The taxiing aircraft are modeled as parked in the locations shown. In addition to the requested modeling, a fifth reflecting source configuration is provided. This configuration consists of the reflecting surfaces described for configuration 4, less the reflections from the B-747 aircraft numbered 25, 26, and 27, which are parallel to the runway opposite airside terminal 4. These results are provided to illustrate the significant

derogative effects caused by large aircraft oriented parallel to the runway in this area. Modeling runs were also made in which these aircraft were rotated in 10^{o} steps with respect to the runway (data not shown). While system derogation was reduced for these runs, Category II/III tolerances were still exceeded at each orientation of the aircraft.

TABLE 1. LOCALIZER ANTENNA MODEL INPUT DATA SUMMARY

Localizer Antenna Type:	Wilcox Mark II, LPD 14-Element, Dual Frequency
Runway 17R Length (ft):	10000.0
Distance to Runway 35L End:	1050.0
Frequency (MHz) - Not yet assigned:	110.0
Site Elevation (ft m.s.l.):	78.0
Course Width (deg):	3.63

14-Element LPD Array

Ant. No.	Spacing (wave length)	Carrier+Sideband Amplitude	Carrier+Sideband Phase (deg)	Sideband Only Amplitude	Sideband Only Phase (deg)
7L	-4.80	0.160	0	0.367	0
6L	-4.05	0.160	0	0.555	0
5L	-3.30	0.491	0	0.889	0
4L	-2.55	0.491	0	1.000	0
3L	-1.80	0.714	0	1.000	0
2L	-1.05	1.000	0	0.667	0
1L	-0.30	0.893	0	0.222	0
1R	0.30	0.893	0	0.222	180
2R	1.05	1.000	0	0.667	180
3R	1.80	0.714	0	1.000	180
4R	2.55	0.491	0	1.000	180
5R	3.30	0.491	0	0.889	180
6R	4.05	0.160	0	0.555	180
7R	4.80	0.160	0	0.367	180

Clearance Signals

Ant. No.	Spacing (wave length)	Carrier+Sideband Amplitude	Carrier+Sideband Phase (deg)	Sideband Only Amplitude	Sideband Only Phase (deg)
3L	-1.80	0.200	0	0.139	0
2L	-1.05	0.000	0	0.333	0
1L	-0.30	1.000	0	1.000	0
1R	0.30	1.000	0	1.000	180
2R	1.05	0.000	0	0.333	180
3R	1.80	0.200	0	0.139	180

ft = feet
MHz = megahertz
m.s.l. = mean sea level
deg = degree

TABLE 2. LOCALIZER REFLECTING SURFACES DATA SUMMARY

Airside 4	Coordinates X	Y	(ft)* Z**	Alpha (deg)	Delta (deg)	Width (ft)	Height (ft)
A	-3572	1461	13	0.0	0.0	90	32
B	-3446	1595	13	210.8	0.0	346	32
C	-3171	1842	13	240.0	0.0	312	43
D	-3105	2205	13	270.0	0.0	348	32
E	-2676	1493	13	330.0	0.0	289	32
F	-3190	1686	13	0.0	0.0	27	103

Aircraft Airside 4	Coordinates X	Y	(ft)* Z**	Alpha (deg)	Delta (deg)	Width (ft)	Height (ft)
7	-2370	1378	19	353.6	0.0	134	15
	-2293	1369	26	353.6	0.0	20	32
8	-2421	1280	19	303.7	0.0	134	15
	-2379	1217	2[illegible]	303.7	0.0	22	32
9	-2532	1263	19	254.3	0.0	133	15
	-2554	1189	26	254.3	0.0	21	32
10	-2672	1340	21	236.1	0.0	129	20
	-2718	1273	29	236.1	0.0	35	44
11	-2829	1440	21	234.2	0.0	133	20
	-2876	1375	29	234.2	0.0	32	44
12	-3165	1501	21	300.3	0.0	131	20
	-3124	1431	29	300.3	0.0	32	44
13	-3327	1402	21	301.0	0.0	131	20
	-3286	1332	29	301.0	0.0	31	44
14	-3477	1308	21	284.1	0.0	131	20
	-3454	1229	29	284.1	0.0	30	44
15	-3615	1288	19	245.8	0.0	134	15
	-3646	1219	26	245.8	0.0	21	32
16	-3712	1363	19	210.7	0.0	136	15
	-3779	1326	26	210.7	0.0	19	32
17	-3741	1502	20	337.3	0.0	196	27
	-3849	1546	31	337.3	0.0	37	46
18	-3590	1651	20	302.2	0.0	194	27
	-3654	1748	31	302.2	0.0	38	46
19	-3387	1780	20	301.9	0.0	194	27
	-3449	1878	31	301.9	0.0	38	46
20	-3185	2030	21	0.0	0.0	130	20
	-3268	2031	29	0.0	0.0	34	44
21	-3187	2219	21	0.0	0.0	129	20
	-3270	2219	29	0.0	0.0	34	44
22	-3185	2386	19	0.0	0.0	134	15
	-3263	2387	26	0.0	0.0	20	32
23	-3150	2498	19	320.0	0.0	133	15
	-3209	2548	26	320.0	0.0	20	32
24	-3051	2563	19	279.8	0.0	132	15
	-3064	2639	26	279.8	0.0	21	32

TABLE 2. LOCALIZER REFLECTING SURFACES DATA SUMMARY (CONTINUED)

Aircraft	Coordinates		(ft)*	Alpha	Delta	Width	Height
Airside 4	X	Y	Z**	(deg)	(deg)	(ft)	(ft)
25	-2525	925	20	0.0	0.0	194	27
	-2640	924	31	0.0	0.0	38	46
26	-2786	945	20	0.0	0.0	197	27
	-2902	946	31	0.0	0.0	37	46
27	-3040	942	20	0.0	0.0	195	27
	-3156	942	31	0.0	0.0	37	46
28	-4044	1537	20	260.6	0.0	194	27
	-4023	1651	31	260.6	0.0	38	46
29	-3855	1974	20	239.5	0.0	195	27
	-3796	2074	31	239.5	0.0	38	46
30	-3296	2853	19	30.6	0.0	133	15
	-3363	2814	26	30.6	0.0	22	32
31	-3067	2901	19	0.0	0.0	133	15
	-3143	2901	26	0.0	0.0	20	32
32	-2873	2851	19	330.5	0.0	133	15
	-2940	2890	26	330.5	0.0	21	32
33	-2720	2686	19	303.1	0.0	130	15
	-2763	2750	26	303.1	0.0	23	32

	Coordinates		(ft)*	Alpha	Delta	Width	Height
Airside 2	X	Y	Z**	(deg)	(deg)	(ft)	(ft)
G	- 533	1466	13	0.0	0.0	90	32
H	- 398	1607	13	209.0	0.0	353	32
I	- 177	1766	13	247.5	0.0	94	43
J	410	1478	13	330.0	0.0	233	32

Aircraft	Coordinates		(ft)*	Alpha	Delta	Width	Height
Airside 2	X	Y	Z**	(deg)	(deg)	(ft)	(ft)
1	- 676	1432	19	355.1	0.0	135	15
	- 752	1440	26	355.1	0.0	20	32
2	- 594	1541	19	334.9	0.0	134	15
	- 664	1574	26	334.9	0.0	20	32
3	- 460	1634	19	334.7	0.0	134	15
	- 529	1667	26	334.7	0.0	20	32
16	719	1467	19	334.3	0.0	134	15
	789	1434	26	334.3	0.0	20	32
17	622	1364	20	282.1	0.0	194	27
	648	1253	31	282.1	0.0	35	46
18	414	1403	20	247.1	0.0	194	27
	370	1297	31	247.1	0.0	36	46
19	191	1495	20	247.0	0.0	194	27
	147	1389	31	247.0	0.0	35	46

TABLE 2. LOCALIZER REFLECTING SURFACES DATA SUMMARY (CONTINUED)

Aircraft Airside 2	Coordinates (ft)* X	Y	Z**	Alpha (deg)	Delta (deg)	Width (ft)	Height (ft)
20	- 129	1516	21	304.7	0.0	131	20
	- 83	1451	29	304.7	0.0	32	44
21	- 283	1407	21	305.5	0.0	130	20
	- 236	1341	29	305.5	0.0	31	44
22	- 421	1314	19	304.2	0.0	132	15
	- 375	1251	26	304.2	0.0	20	32
23	- 535	1279	19	264.7	0.0	134	15
	- 542	1203	26	264.7	0.0	20	32
24	- 644	1326	19	224.8	0.0	134	15
	- 699	1271	26	224.8	0.0	20	32
28	765	1097	20	204.7	0.0	193	27
	661	1050	31	204.7	0.0	39	46
29	301	1003	20	4.5	0.0	193	27
	185	993	31	4.5	0.0	37	46
30	- 742	959	19	335.6	0.0	132	15
	- 673	927	26	335.6	0.0	21	32
31	- 912	1119	19	304.5	0.0	132	15
	- 867	1056	26	304.5	0.0	25	32
32	- 981	1307	19	274.9	0.0	133	15
	- 974	1229	26	274.9	0.0	20	32
33	- 933	1526	19	249.2	0.0	132	15
	- 960	1454	26	249.2	0.0	20	32

* Midpoint of base of surface referenced to threshold of runway 17R.

** Referenced to base of antenna.

DATA PRESENTATION.

Modeled output results for the localizer are provided on three types of plots: (1) course structure plots, (2) clearance orbit plots, and (3) carrier plus sideband (CSB) and sideband only (SBO) antenna pattern plots. The simulated flightpaths for the course structure runs are centerline approaches starting 60,000 feet from runway threshold. The aircraft crosses the runway threshold at the threshold crossing height and continues at this altitude to a point just short of the stop end of the runway. Distances shown on the horizontal axis of the course structure plots are referenced to the approach threshold. Negative values are shown for distances between the threshold and the localizer. Positive values apply to distances on the approach path toward the outer marker. Angular values on the horizontal axes of the CSB and SBO antenna pattern plots and on the clearance orbit plots were run with flight arcs of 35,000 feet at altitudes of 1,000 feet, with respect to the localizer site.

The vertical axes of the course structure and clearance orbit plots are the model output values of CDI deflection in microamps (0.4-second time constant applied for smoothing). The vertical axes of the antenna pattern plots use a relative scale with the pattern normalized to its peak value. The usual range

for the vertical scale of modeled course structure data plots is +40 to -40 microamps. This range has been reduced to +10 to -10 microamps for several of the course structure plots provided in this study in order to better display small values of CDI deflection. This choice of scale eliminates the display of category I limits from the plot and shows only the final segment of the category II tolerance limits. Category III tolerance limits (not shown) extend the 5-microamp tolerance shown for category II performance to a point on the runway 3,000 feet from threshold. The limits then increase linearly to 10 microamps at a point which is 2,000 feet from the stop end of the runway.

Modeled localizer output data are provided in figures 4 through 18. Figures 4 through 6 provide computed performance results with airside 4 as the only reflecting source. Modeled course structure is plotted in figure 4. Computed clearance orbit results are given in figure 5. Figure 6 shows the computed CSB and SBO antenna pattern plots. Figures 7 through 9 provide similar plots for the reflecting surface configuration consisting of airside 4 with simulated docked and taxiing aircraft. Figures 10 through 12 show computed performance results for the two airside terminals with no simulated aircraft. The computed performance results for the reflecting surface combination consisting of both airsides 4 and 2 with simulated docked and taxiing aircraft at each airside are provided in figures 13 through 15. Figures 16 through 18 show computed performance results for the two airside terminals with docked and taxiing aircraft at each airside, excluding three B-747 aircraft taxiing parallel to the runway opposite airside terminal 4.

DATA ANALYSIS.

Modeled course structure results for airside 4 alone, and airsides 4 and 2 with no docked and no taxiing aircraft (figures 4 and 10, respectively) show computed CDI deflections that are well within category II/III course structure tolerance limits. Figure 7 (airside 4 with docked and taxiing aircraft) and figure 13 (airsides 4 and 2 with docked and taxiing aircraft) course structure results show computed CDI deflections that exceed the category II/III tolerance limits. Figure 16 (airsides 4 and 2 with docked and taxiing aircraft, excluding parallel taxiing aircraft) marginally meets the category II/III tolerance limits. The computed clearance orbit plots (figures 5, 8, 11, 14, and 17) indicate satisfactory linearity, course crossover, and clearance levels. Figures 6, 9, 12, 15, and 18, CSB and SBO antenna patterns for the Marks II antenna array, show some roughness in the computed clearance signals on the 150 hertz (Hz) side of the pattern.

CONCLUSIONS

Modeled results indicate that marginal category II/III localizer performance should be obtained with the Wilcox Mark II, 14-element, dual frequency log periodic dipole (LPD) antenna array with both airside terminals and docked and taxiing aircraft, excluding aircraft taxiing parallel to the runway, located as proposed. Category II/III tolerance limits are exceeded when the parallel taxiing aircraft are included in the reflecting source configuration, as provided on the airport ramp utilization plan, Scheme IIIA. Computed clearance orbit results indicate satisfactory linearity, course crossover, and clearance levels.

REFERENCES

1. Chin, G., et al., Instrument Landing System Scattering, Report DOT/FAA-RD-72-137, 1972.

2. Chin, G., et al., User's Manual for ILSLOC: Simulation for Derogation Effects on the Localizer Portion of the Instrument Landing System, Report DOT/FAA-RD-73-13, 1973.

3. Chin, G., et al., Instrument Landing System Performance Prediction, Report DOT/FAA-RD-73-200, 1974.

4. Chin, G., et al., ILS Localizer Performance Study, Part I, Dallas-Fort Worth Regional Airport and Model Validation, Syracuse Hancock Airport, Report DOT/FAA-RD-72-96, 1972.

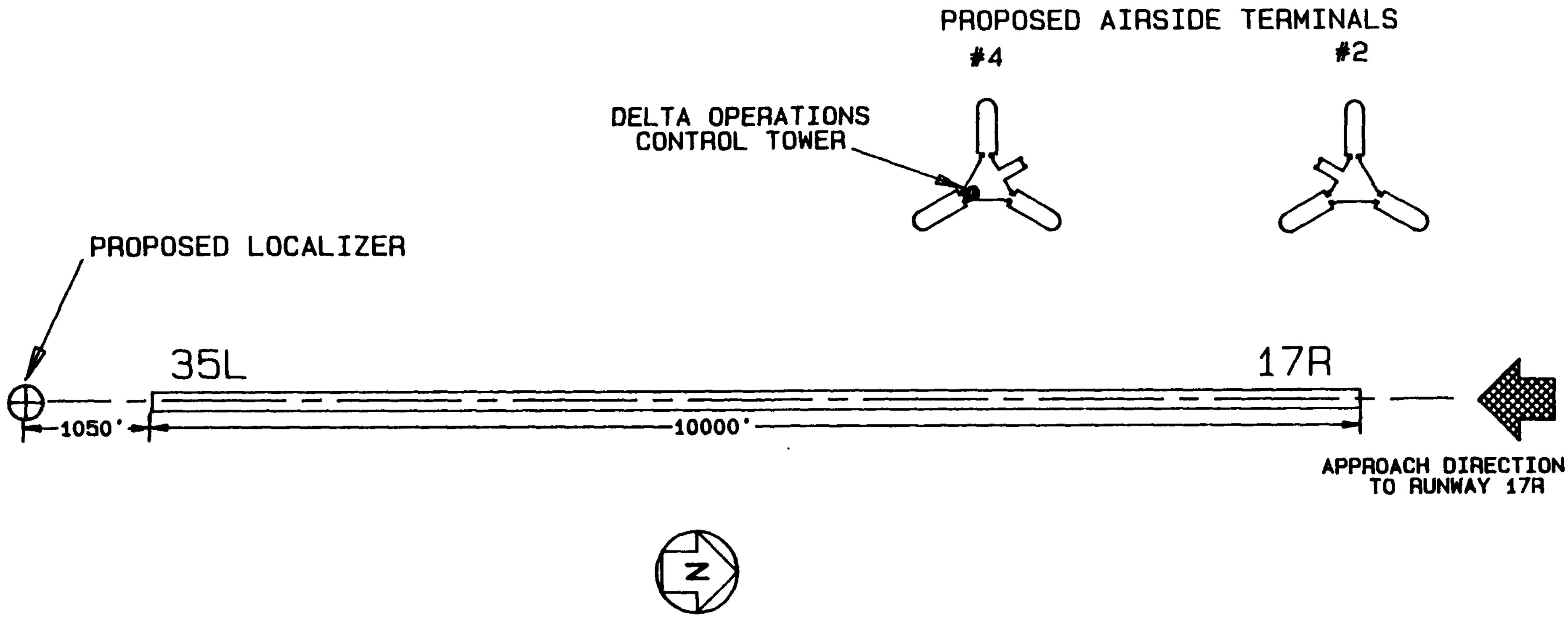

FIGURE 1. ORLANDO RUNWAY 17R, ILS MATH MODELING LAYOUT

PROPOSED AIRSIDE TERMINALS
AIRCRAFT DOCKING PLAN
(SCHEME IIIA)

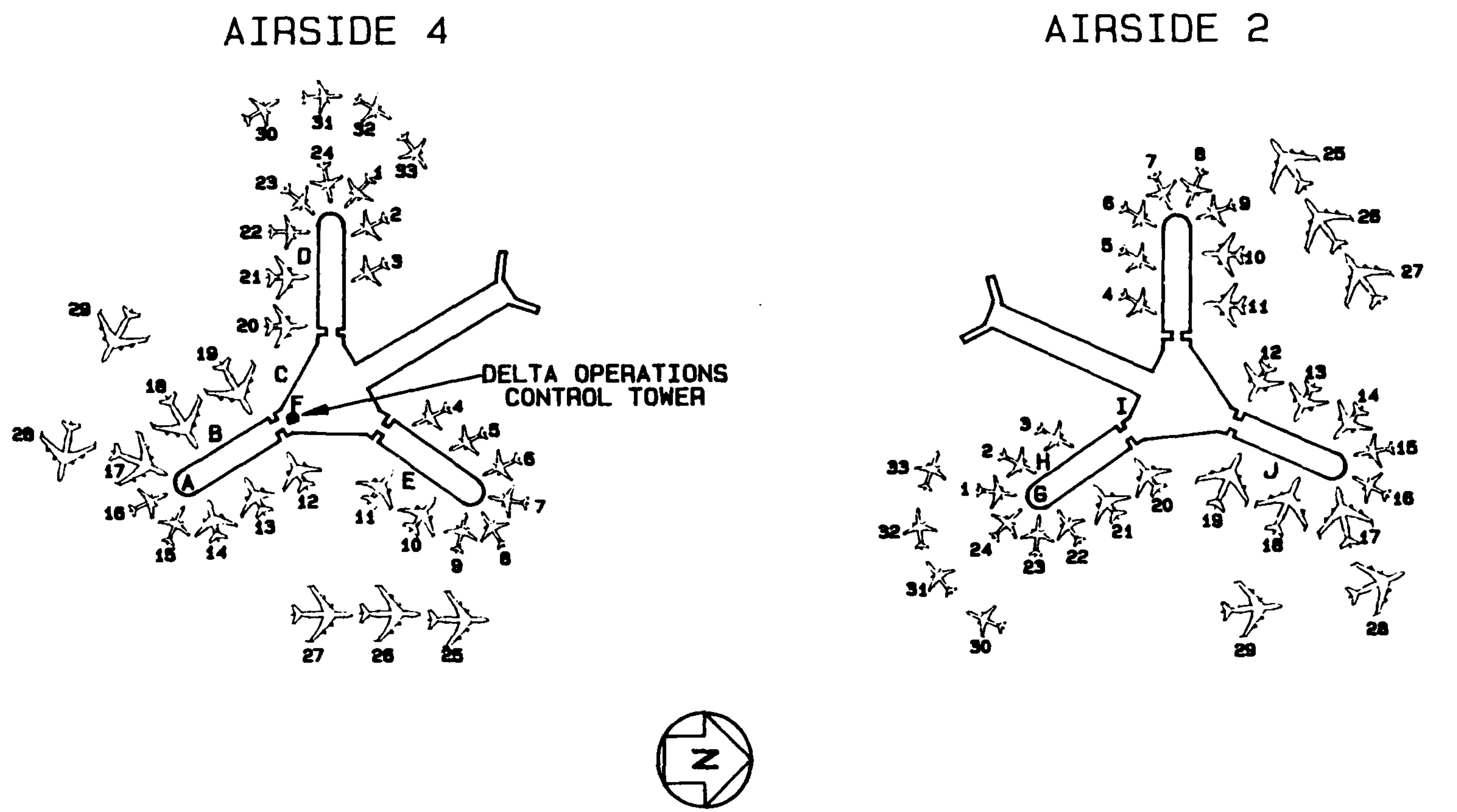

FIGURE 2. ORLANDO RUNWAY 17R, PROPOSED AIRSIDE TERMINALS AND SIMULATED DOCKED AND TAXIING AIRCRAFT DETAILS, SCHEME IIIA

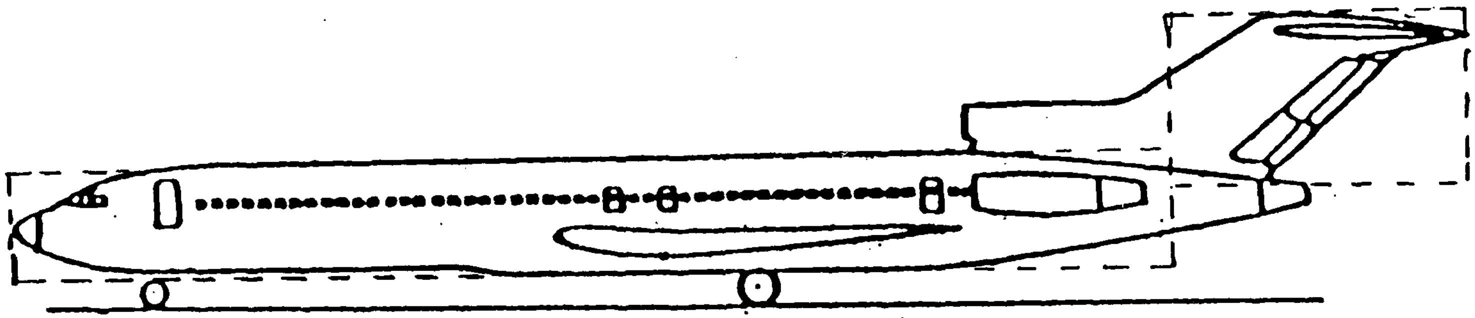

FIGURE 3. TYPICAL AIRCRAFT REFLECTOR PLATE SILHOUETTE

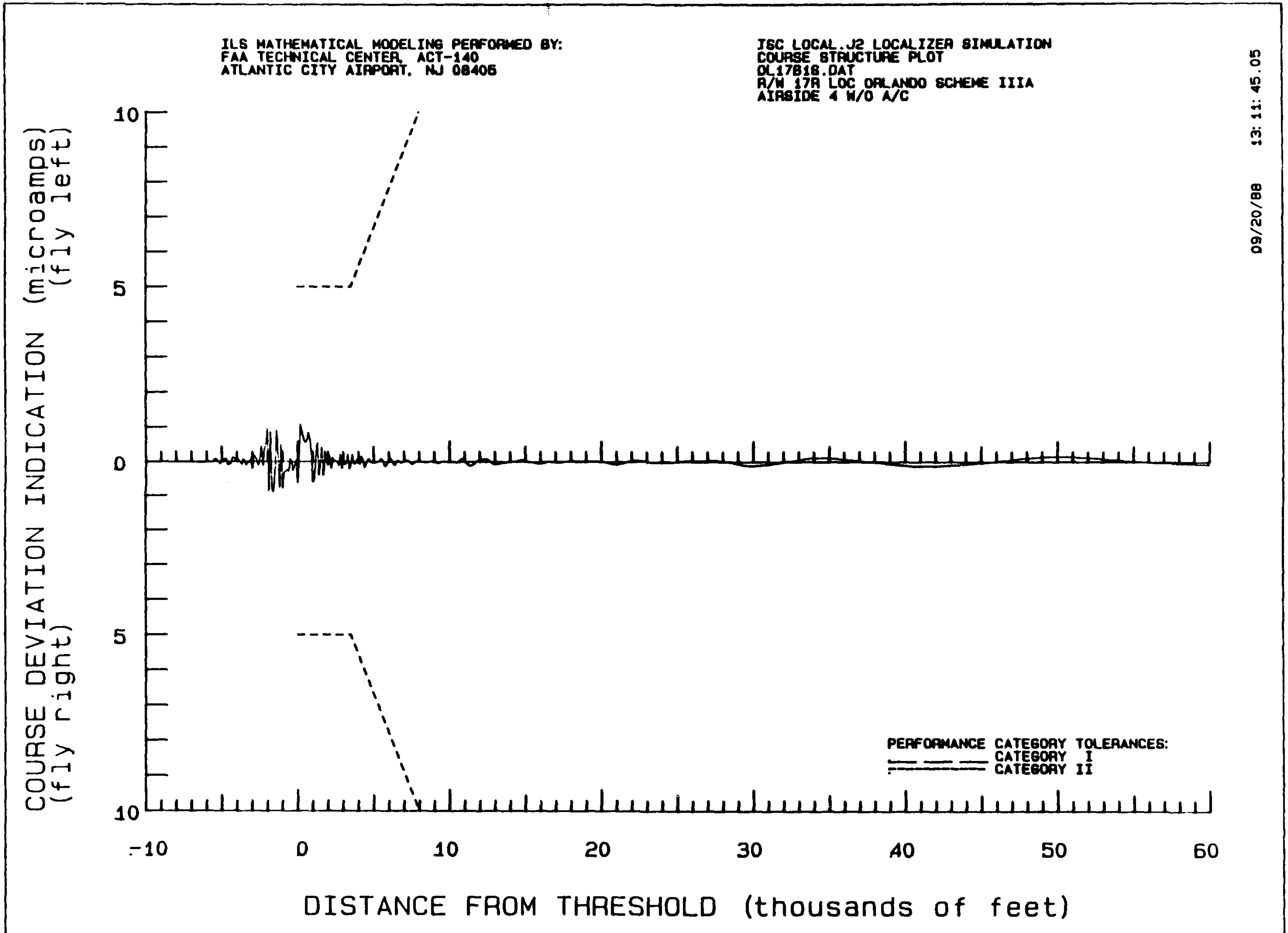

FIGURE 4. COURSE STRUCTURE, ORLANDO RUNWAY 17R LOCALIZER, AIRSIDE TERMINAL 4, NO DOCKED AIRCRAFT, NO TAXIING AIRCRAFT

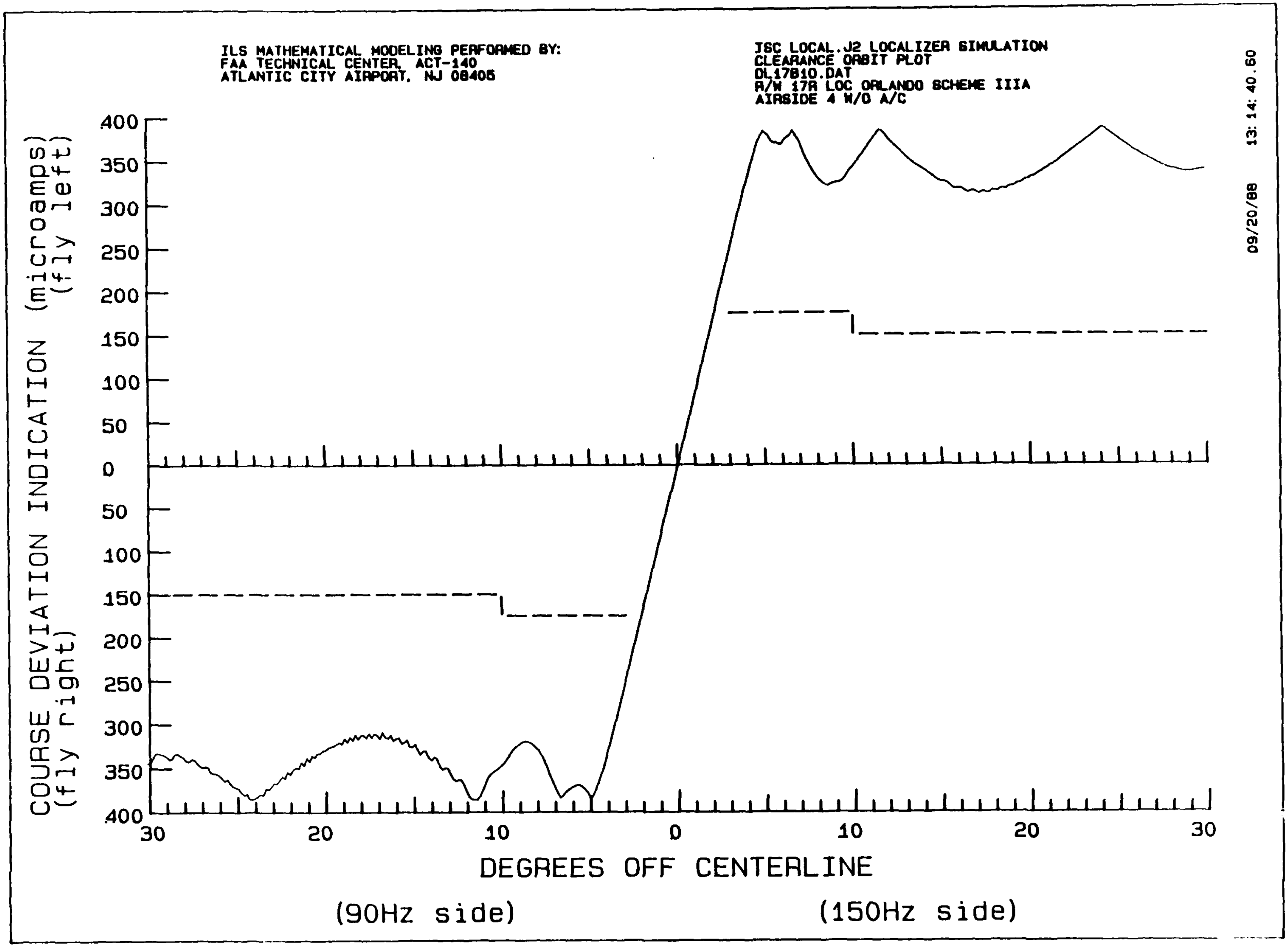

FIGURE 5. CLEARANCE ORBIT, ORLANDO RUNWAY 17R LOCALIZER, AIRSIDE TERMINAL 4, NO DOCKED AIRCRAFT, NO TAXIING AIRCRAFT

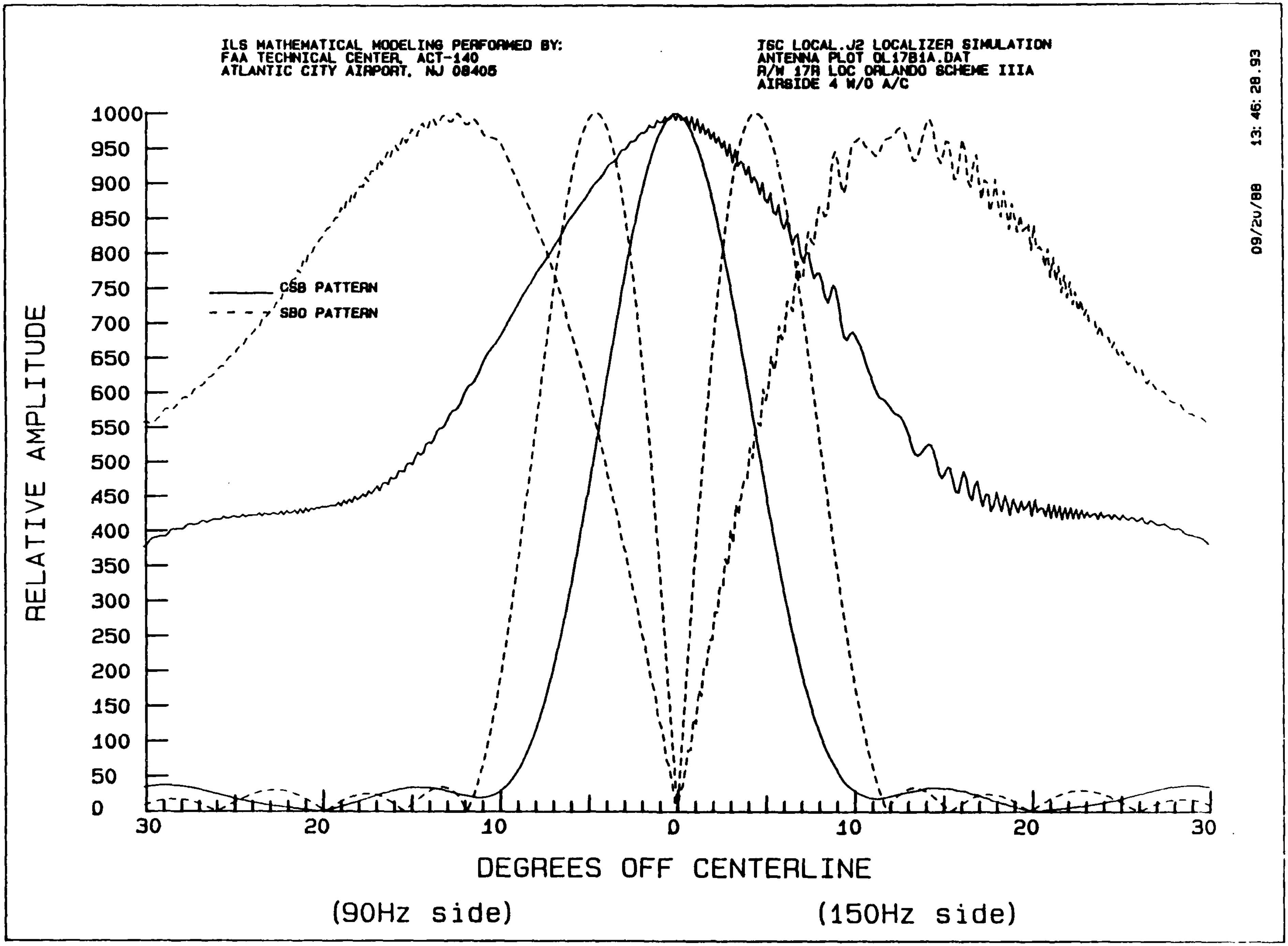

FIGURE 6. CSB AND SBO ANTENNA PATTERNS, ORLANDO RUNWAY 17R LOCALIZER, AIRSIDE TERMINAL 4, NO DOCKED AIRCRAFT, NO TAXIING AIRCRAFT

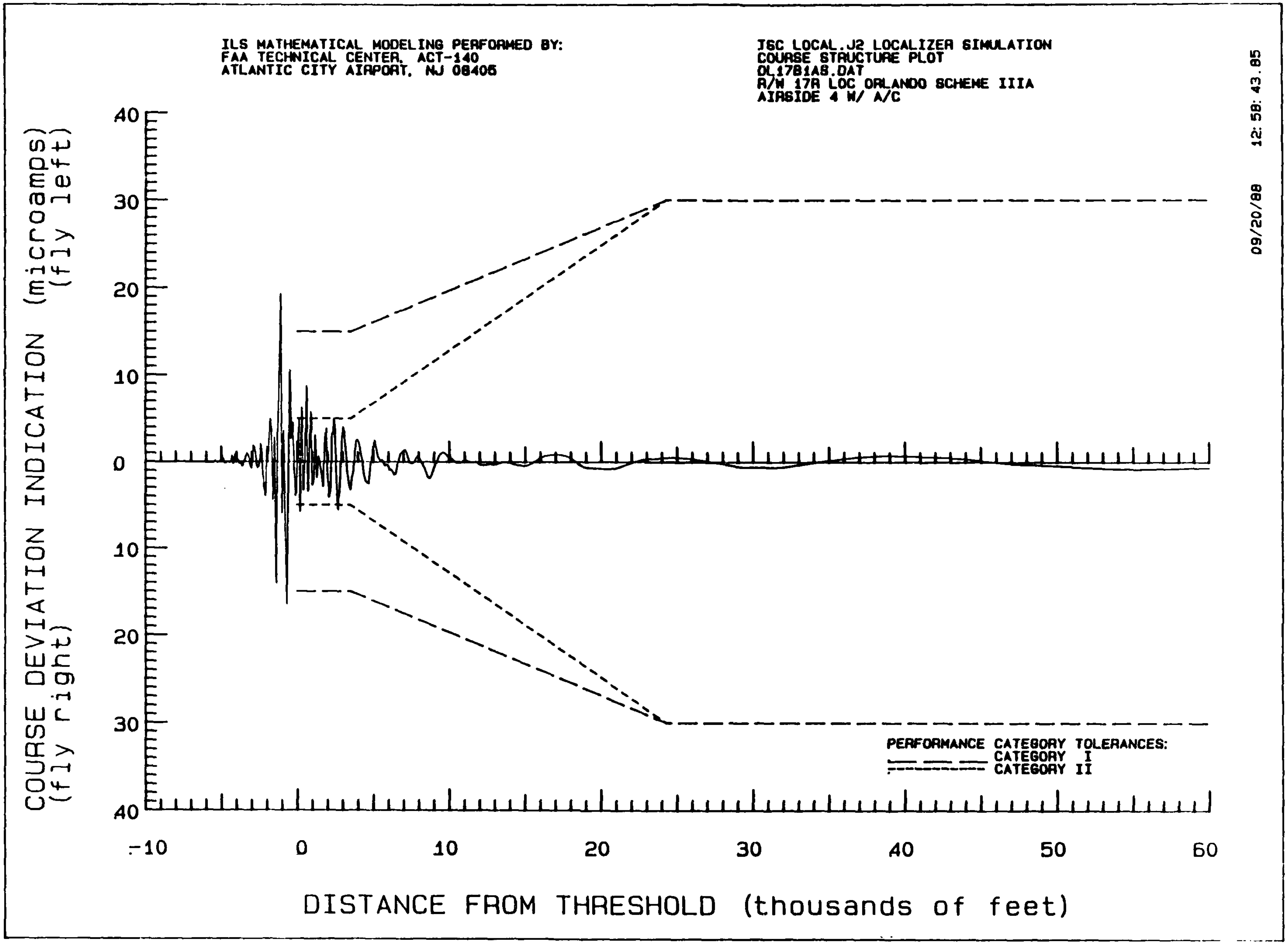

FIGURE 7. COURSE STRUCTURE, ORLANDO RUNWAY 17R LOCALIZER, AIRSIDE TERMINAL 4, DOCKED AND TAXIING AIRCRAFT

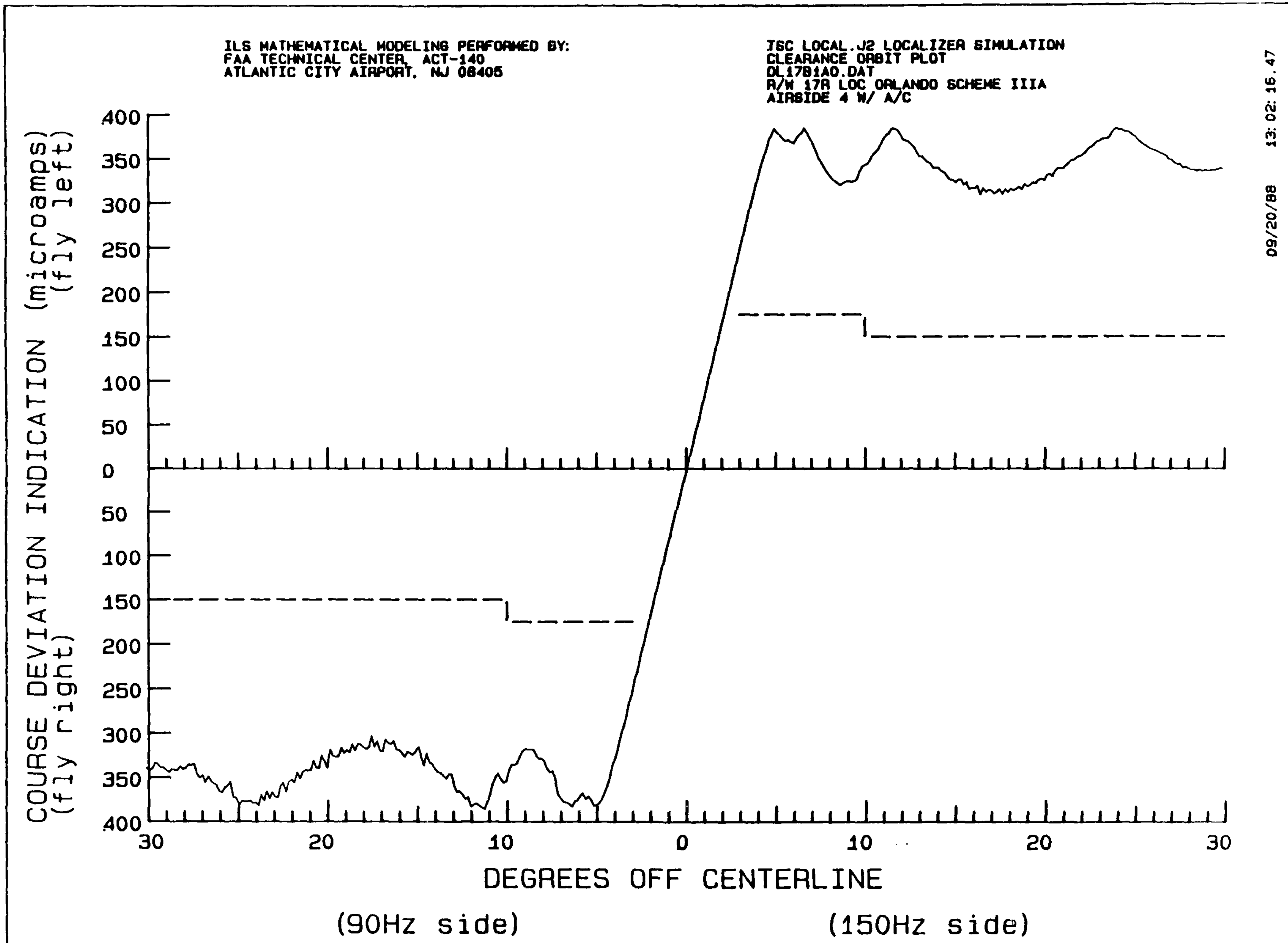

FIGURE 8. CLEARANCE ORBIT, ORLANDO RUNWAY 17R LOCALIZER, AIRSIDE TERMINAL 4, DOCKED AND TAXIING AIRCRAFT

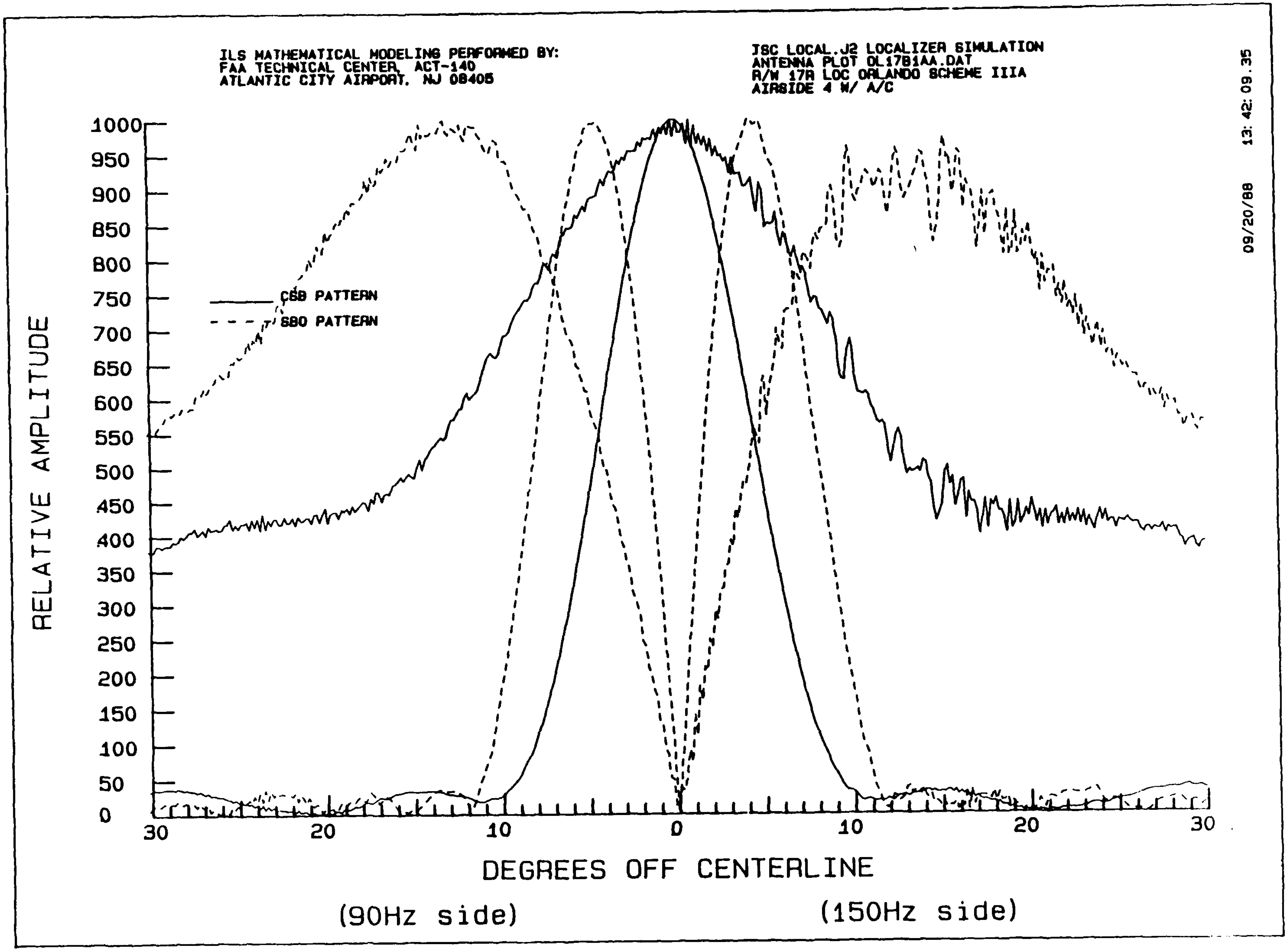

FIGURE 9. CSB AND SBO ANTENNA PATTERNS, ORLANDO RUNWAY 17R LOCALIZER, AIRSIDE TERMINAL 4, DOCKED AND TAXIING AIRCRAFT

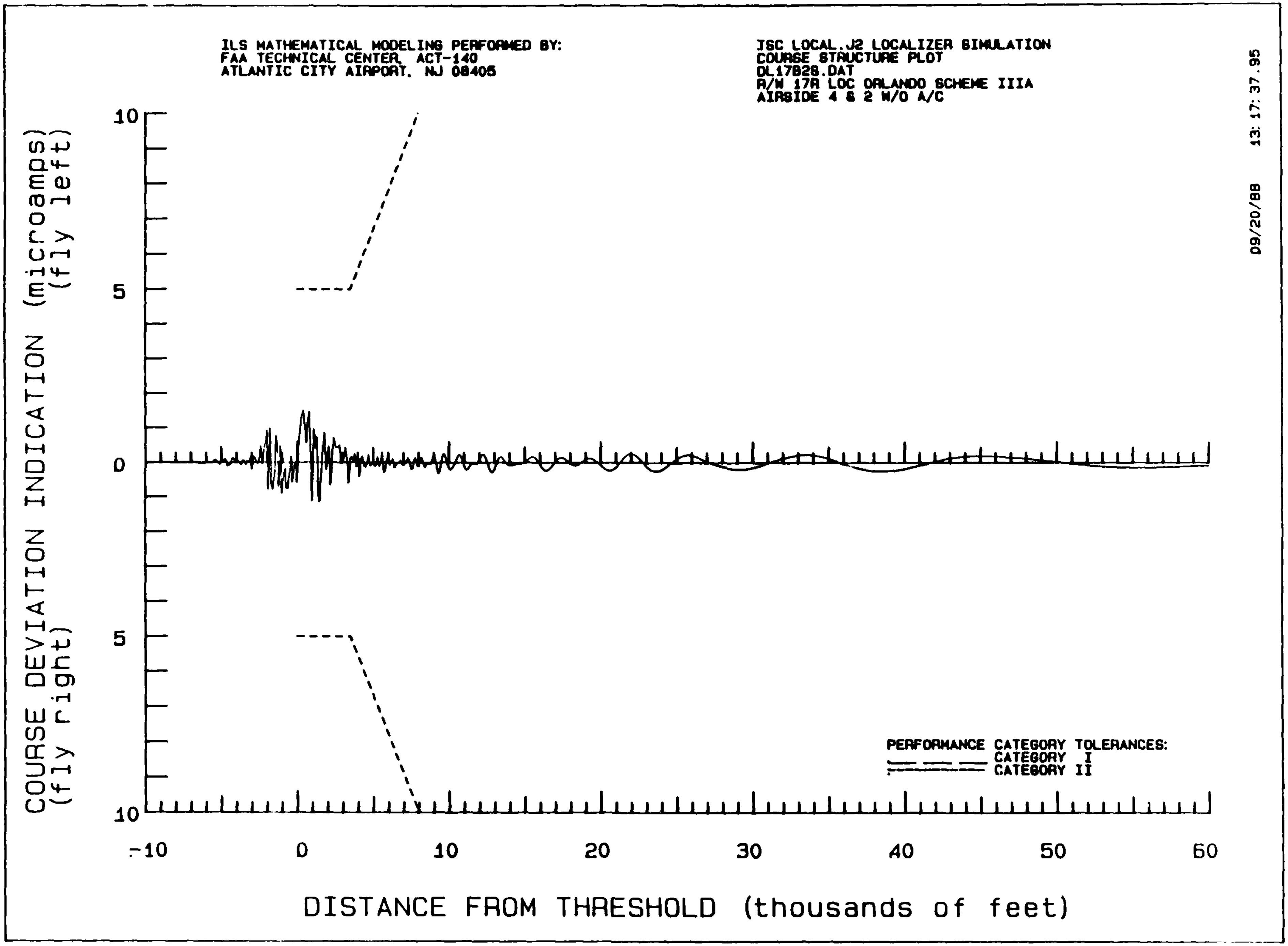

FIGURE 10. COURSE STRUCTURE, ORLANDO RUNWAY 17R LOCALIZER, AIRSIDE TERMINALS 4 AND 2, NO DOCKED AIRCRAFT, NO TAXIING AIRCRAFT

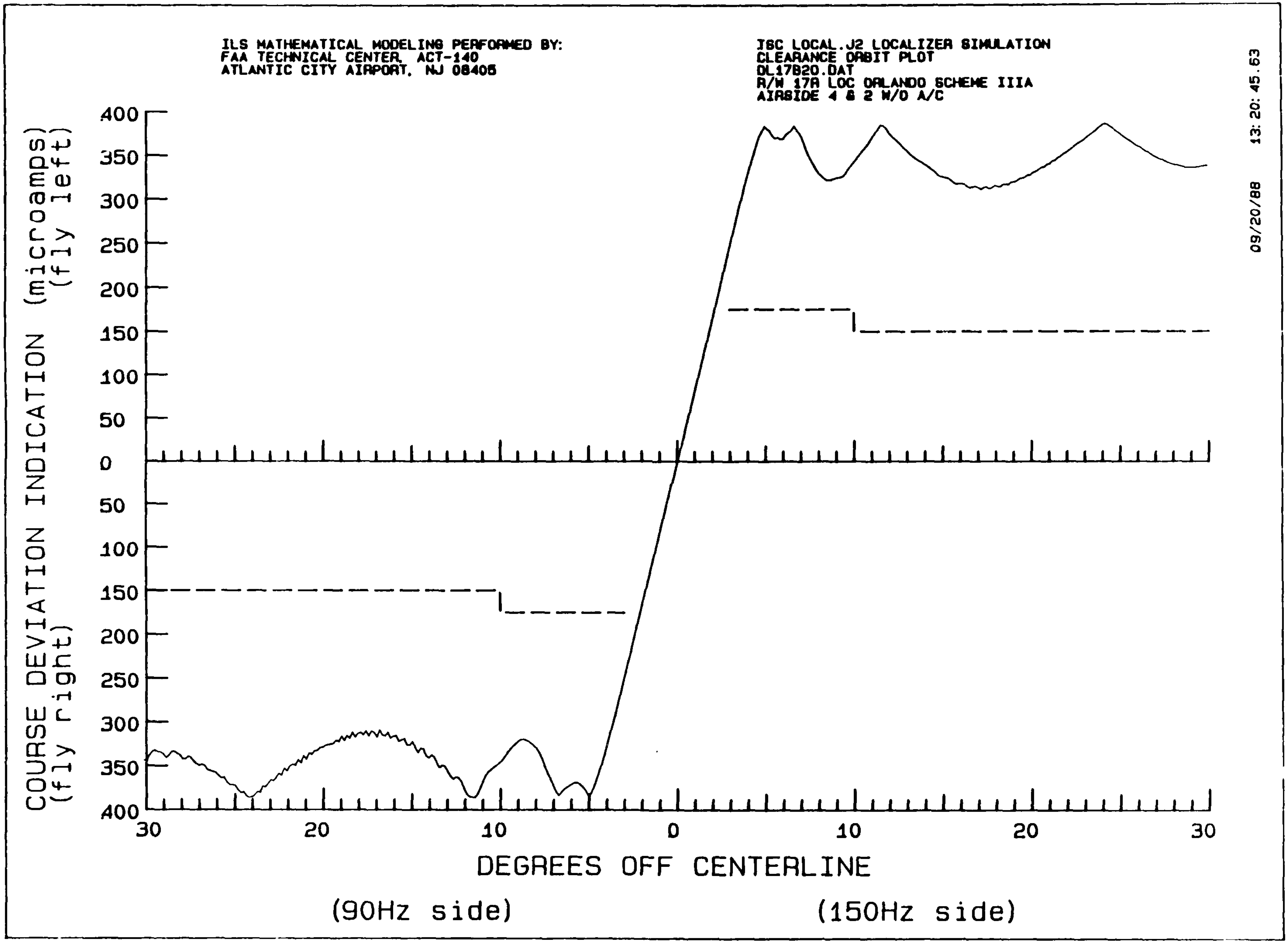

FIGURE 11. CLEARANCE ORBIT, ORLANDO RUNWAY 17R LOCALIZER, AIRSIDE TERMINALS 4 AND 2, NO DOCKED AIRCRAFT, NO TAXIING AIRCRAFT

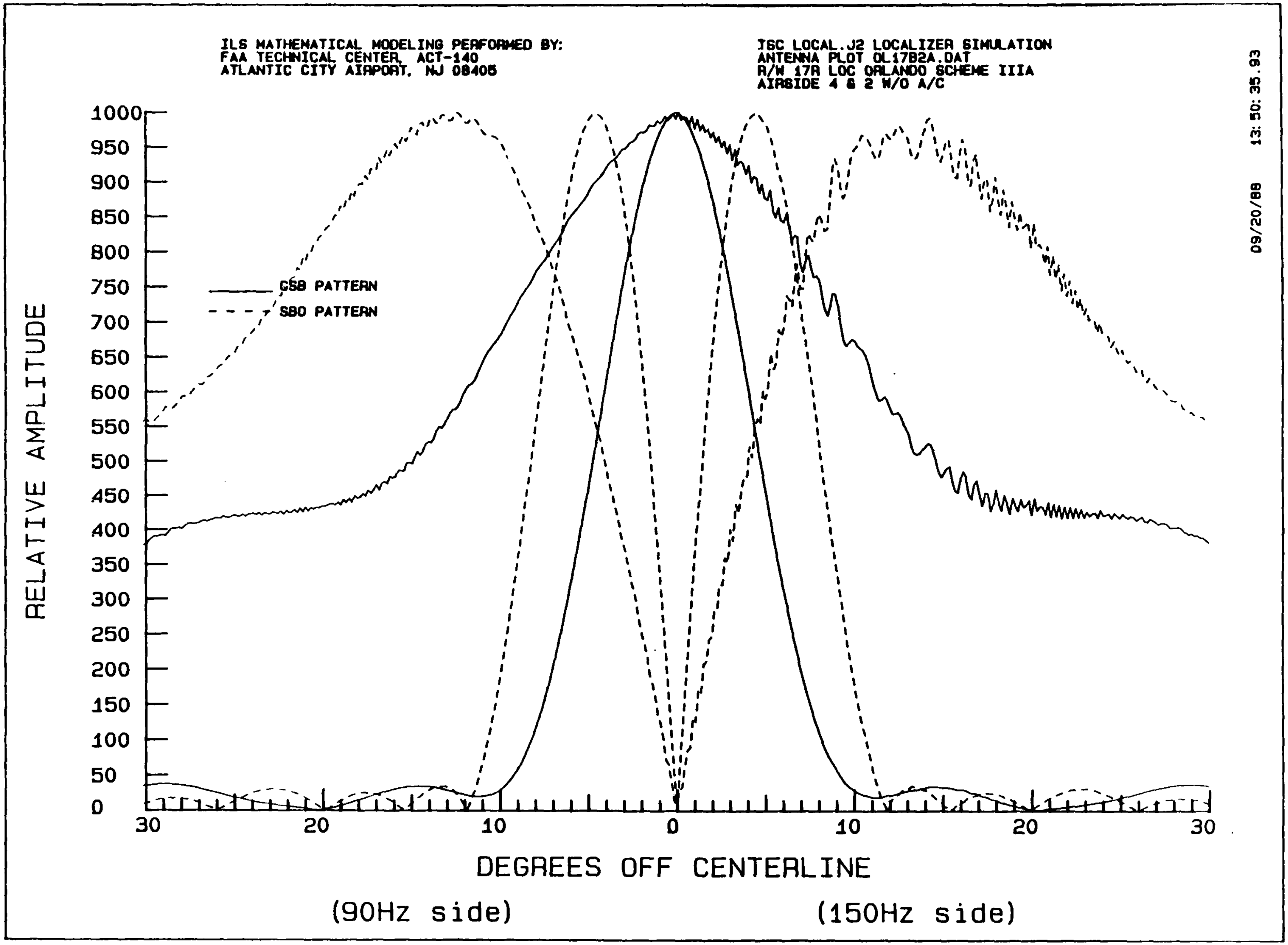

FIGURE 12. CSB AND SBO ANTENNA PATTERNS, ORLANDO RUNWAY 17R LOCALIZER, AIRSIDE TERMINALS 4 AND 2, NO DOCKED AIRCRAFT, NO TAXIING AIRCRAFT

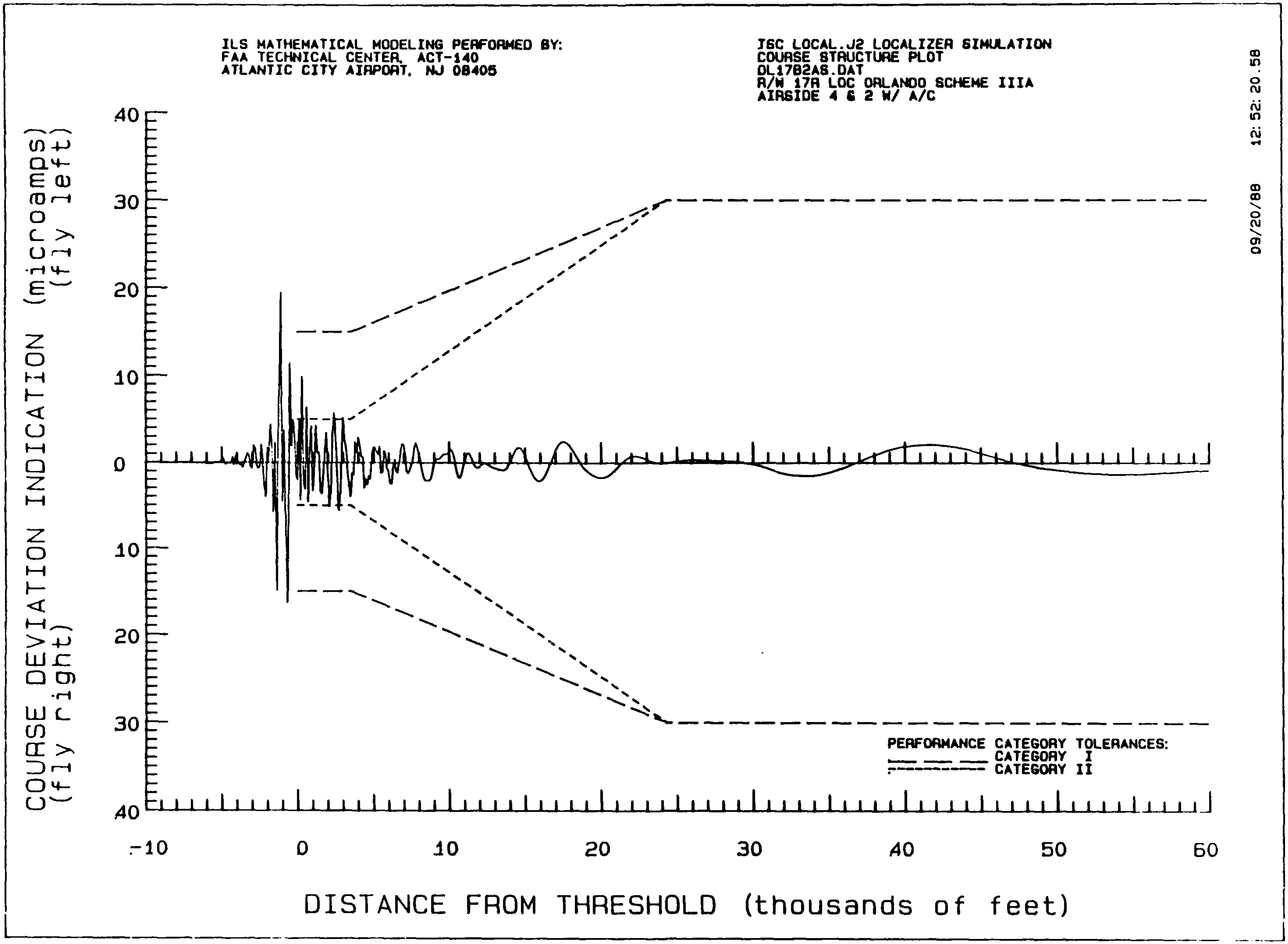

FIGURE 13. COURSE STRUCTURE, ORLANDO RUNWAY 17R LOCALIZER, AIRSIDE TERMINALS 4 AND 2, DOCKED AND TAXIING AIRCRAFT

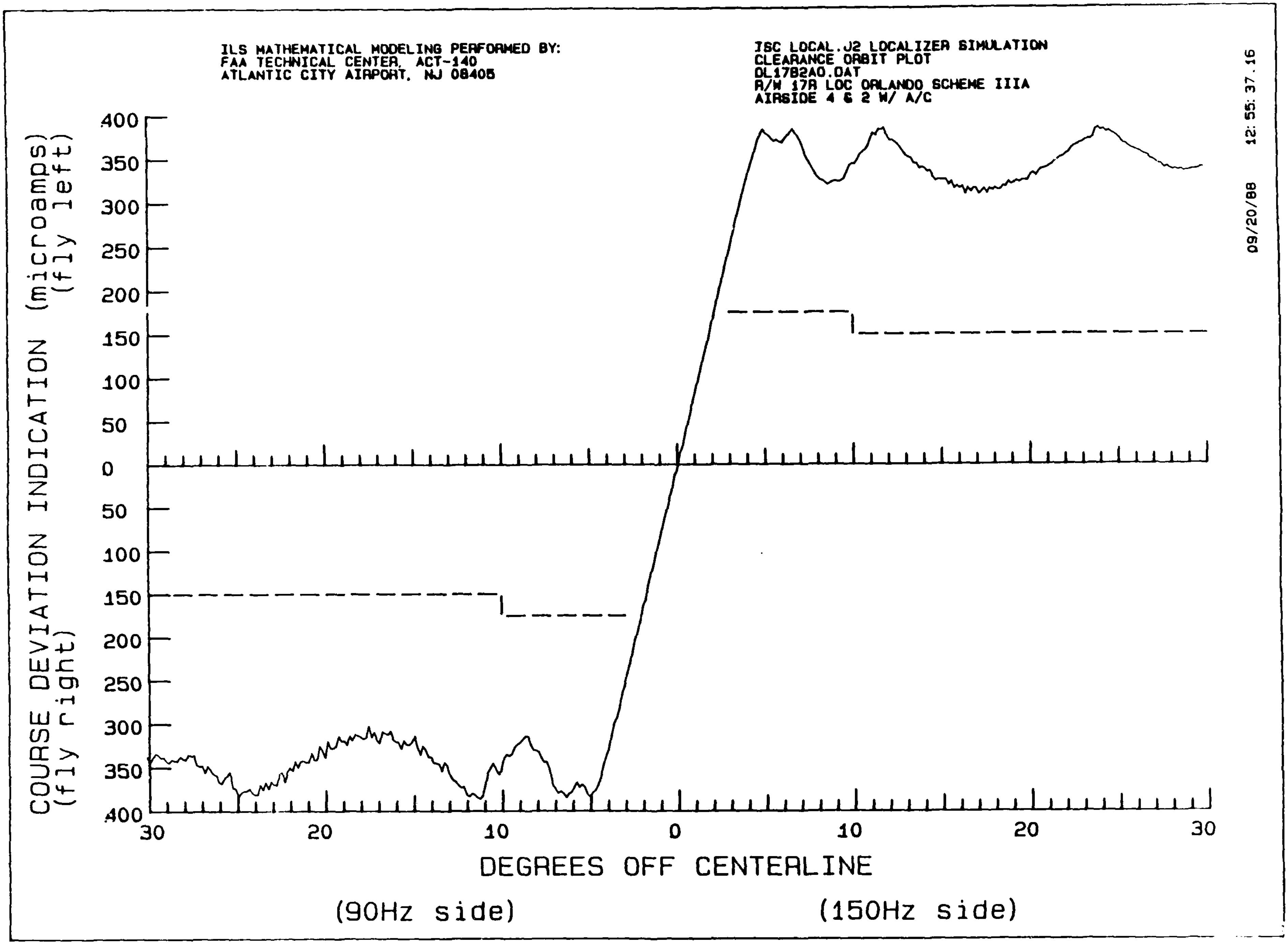

FIGURE 14. CLEARANCE ORBIT, ORLANDO RUNWAY 17R LOCALIZER, AIRSIDE TERMINALS 4 AND 2, DOCKED AND TAXIING AIRCRAFT

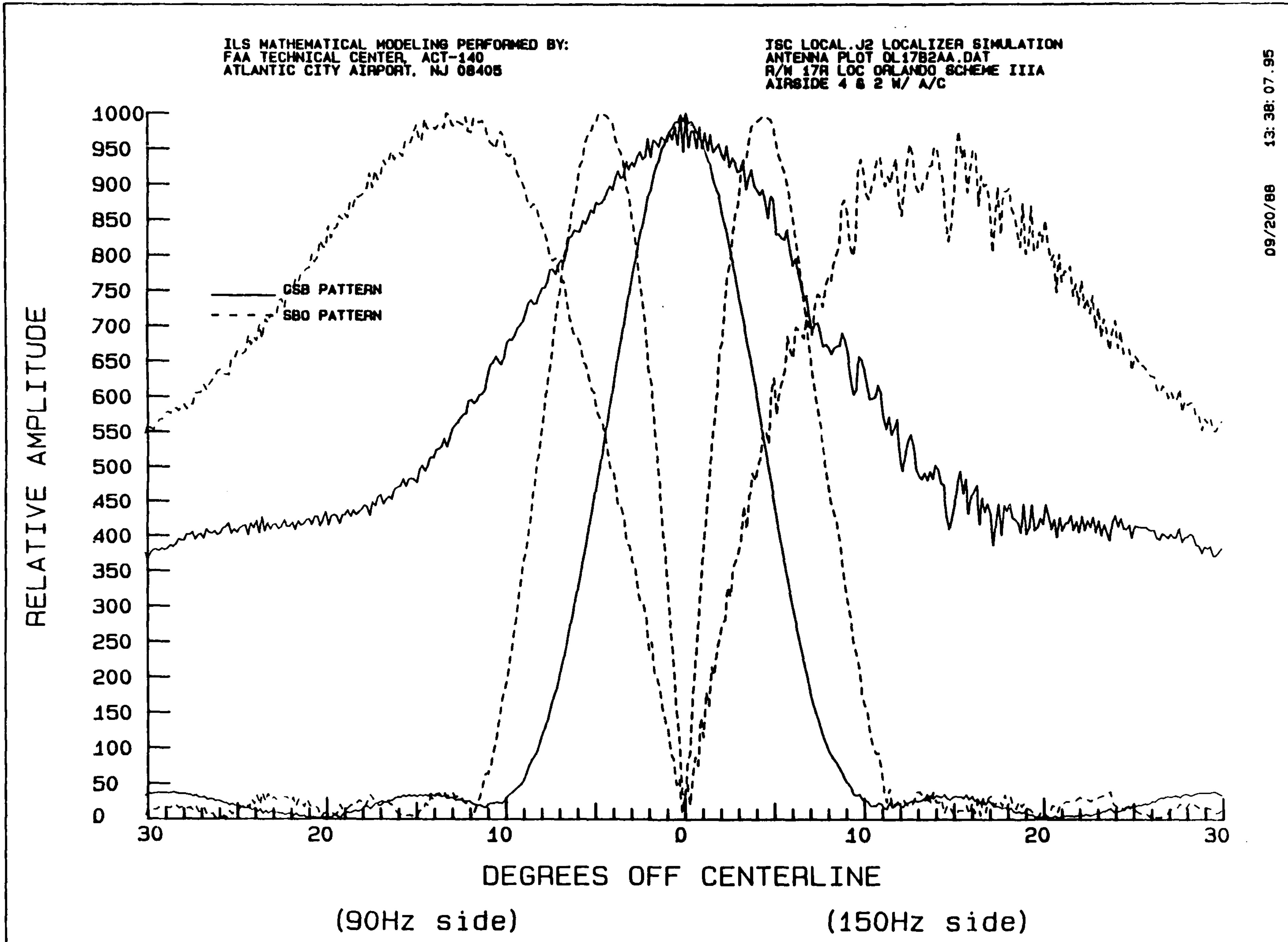

FIGURE 15. CSB AND SBO ANTENNA PATTERNS, ORLANDO RUNWAY 17R LOCALIZER, AIRSIDE TERMINALS 4 AND 2, DOCKED AND TAXIING AIRCRAFT

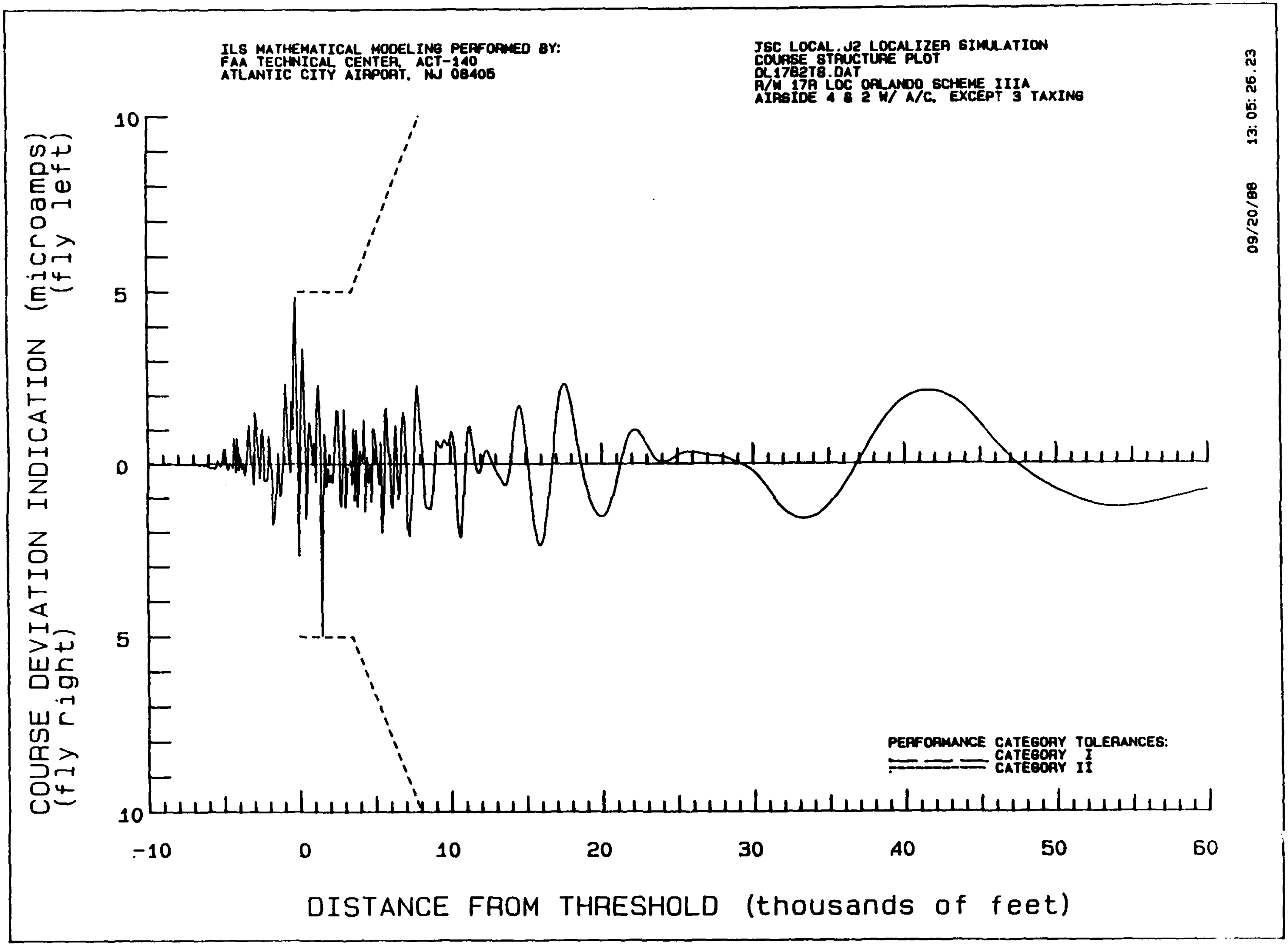

FIGURE 16. COURSE STRUCTURE, ORLANDO RUNWAY 17R LOCALIZER, AIRSIDE TERMINALS 4 AND 2, DOCKED AND TAXIING AIRCRAFT, EXCLUDING PARALLEL TAXIING AIRCRAFT

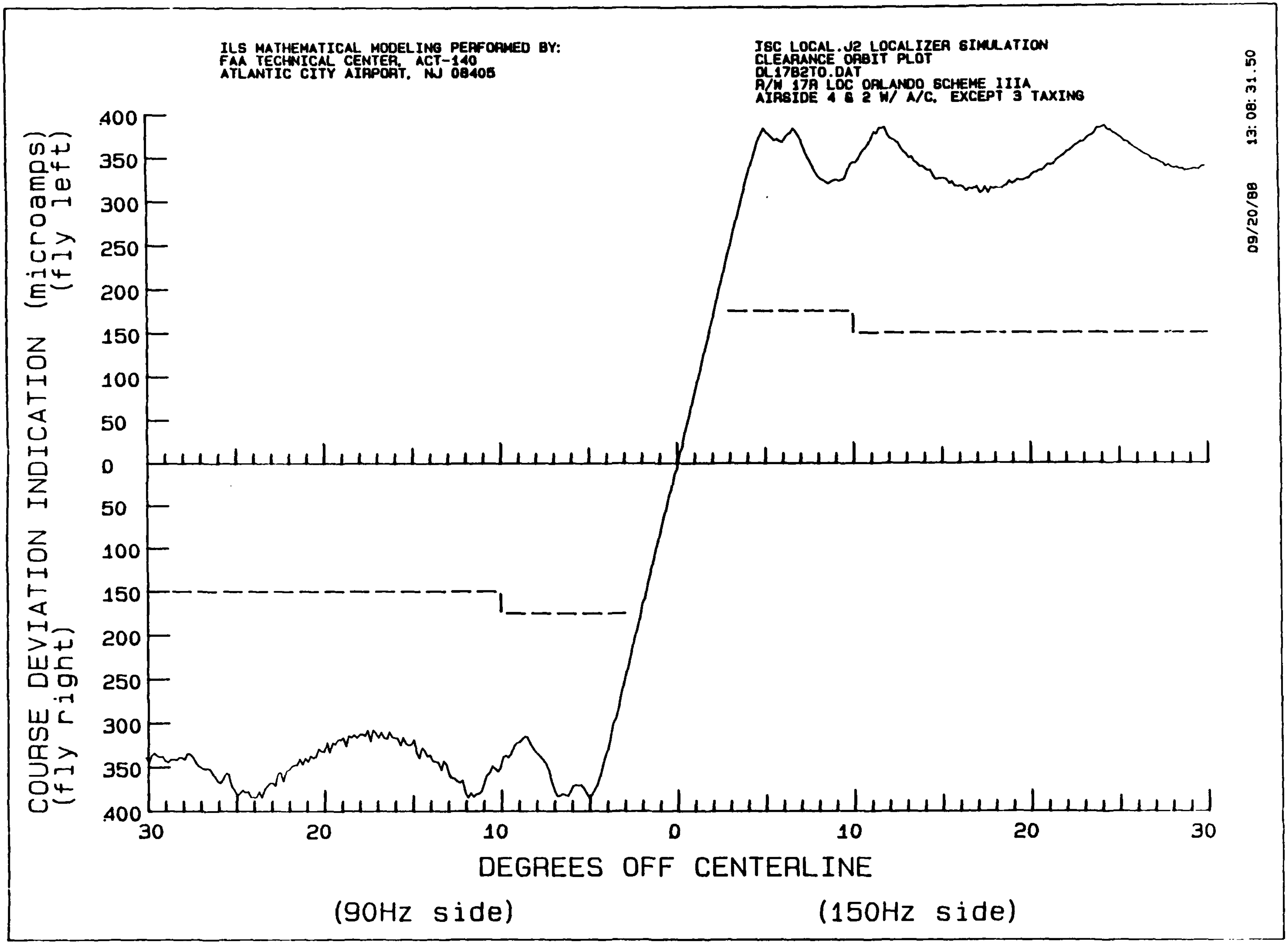

FIGURE 17. CLEARANCE ORBIT, ORLANDO RUNWAY 17R LOCALIZER, AIRSIDE TERMINALS 4 AND 2, DOCKED AND TAXIING AIRCRAFT, EXCLUDING PARALLEL TAXIING AIRCRAFT

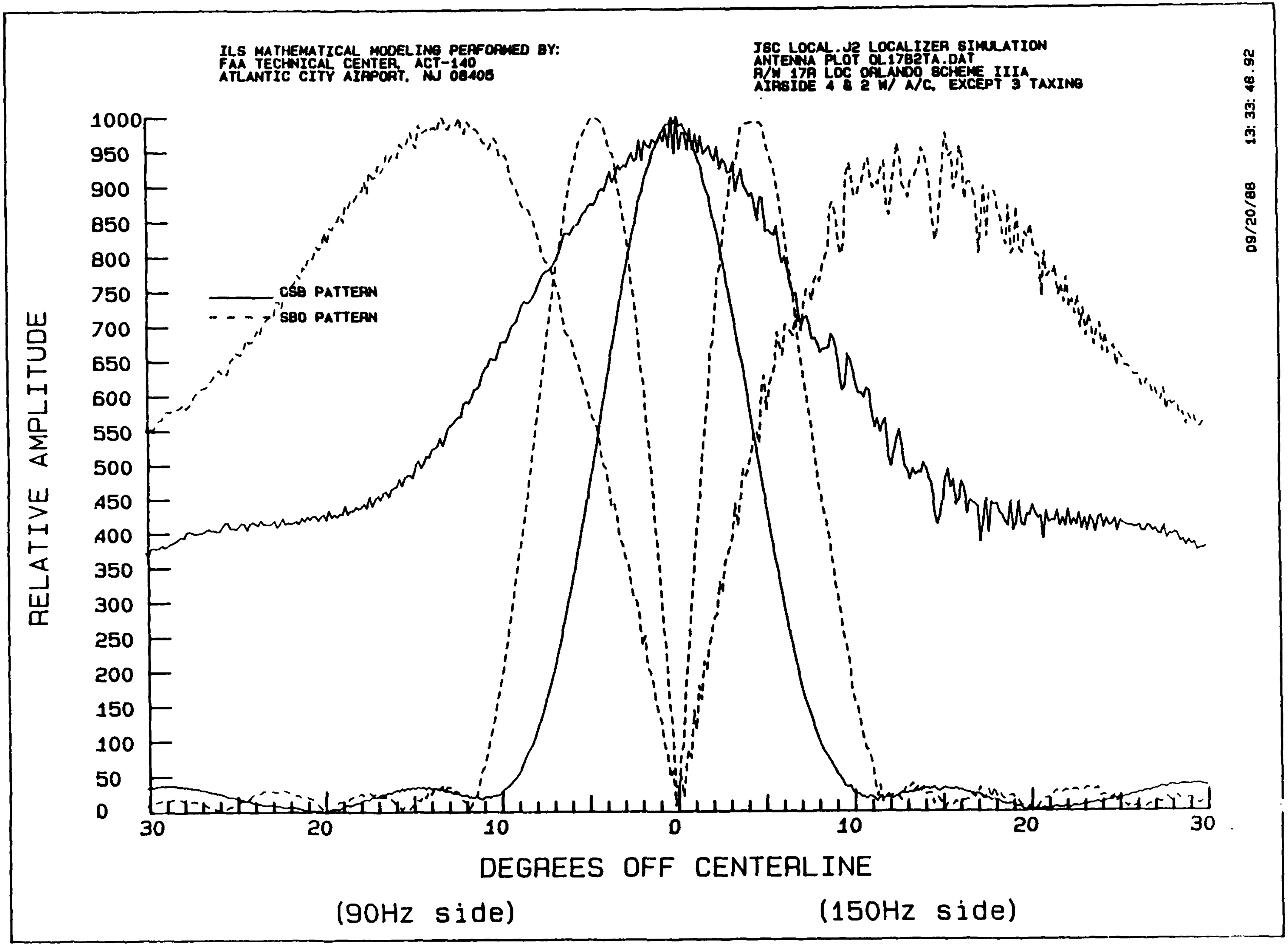

FIGURE 18. CSB AND SBO ANTENNA PATTERNS, ORLANDO RUNWAY 17R LOCALIZER, AIRSIDE TERMINALS 4 AND 2, DOCKED AND TAXIING AIRCRAFT, EXCLUDING PARALLEL TAXIING AIRCRAFT